Lightning : An Essential Climate Variable

WMO/GCOS Task Team on Lightning Observations For Climate Applications (TT-LOCA) – Final Report

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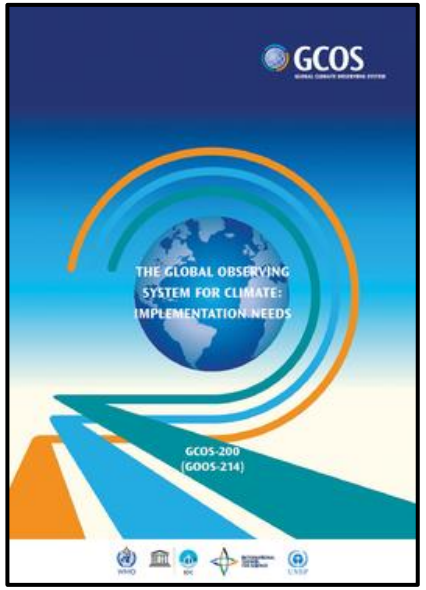

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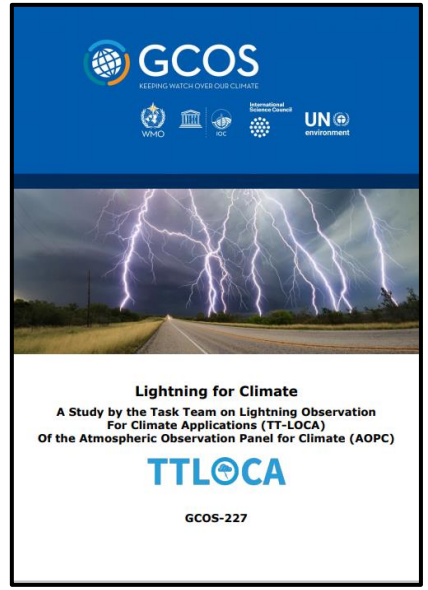
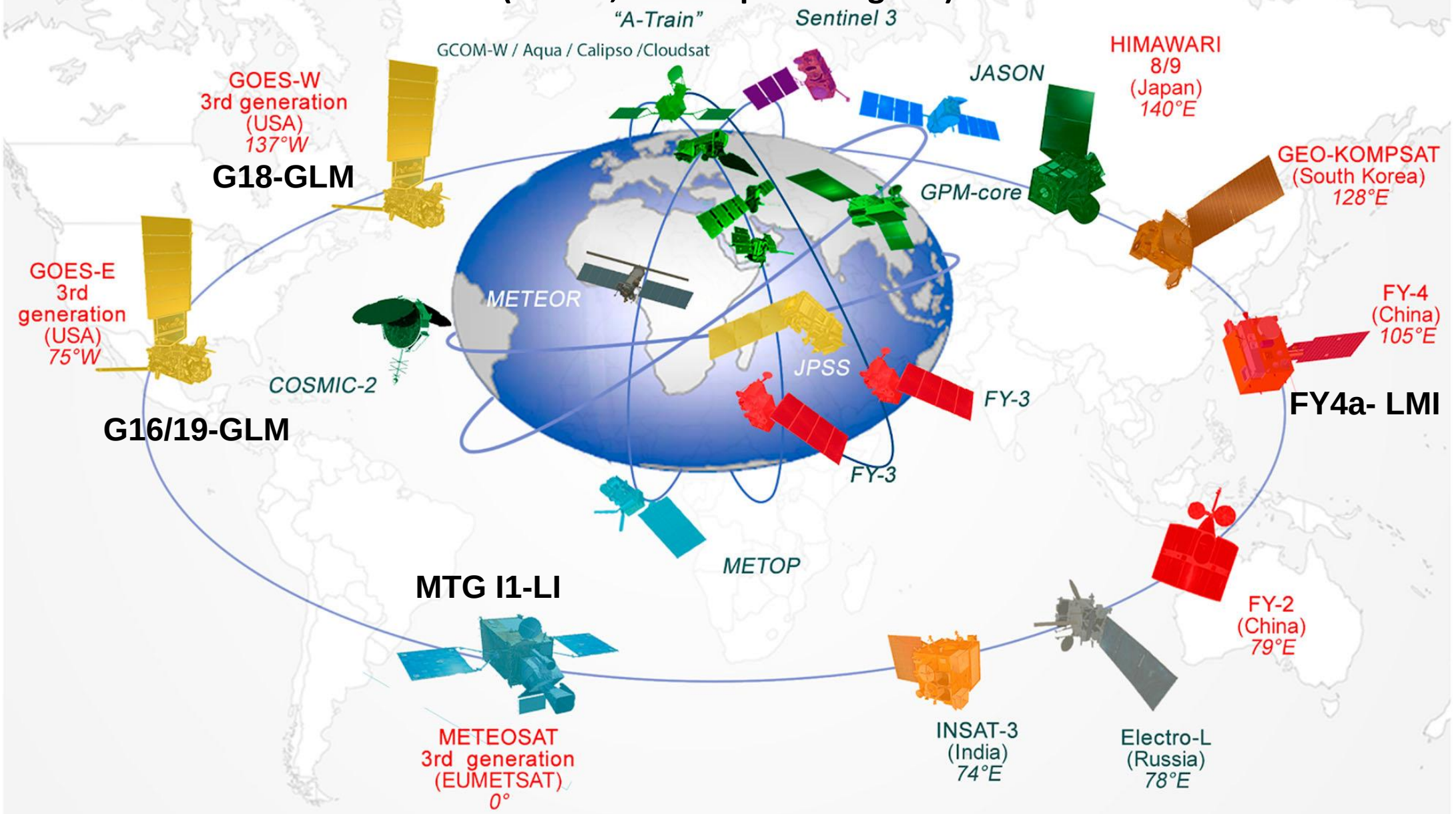


GLM Lightning Science Meeting, 24-26 September 2024
Huntsville, AL

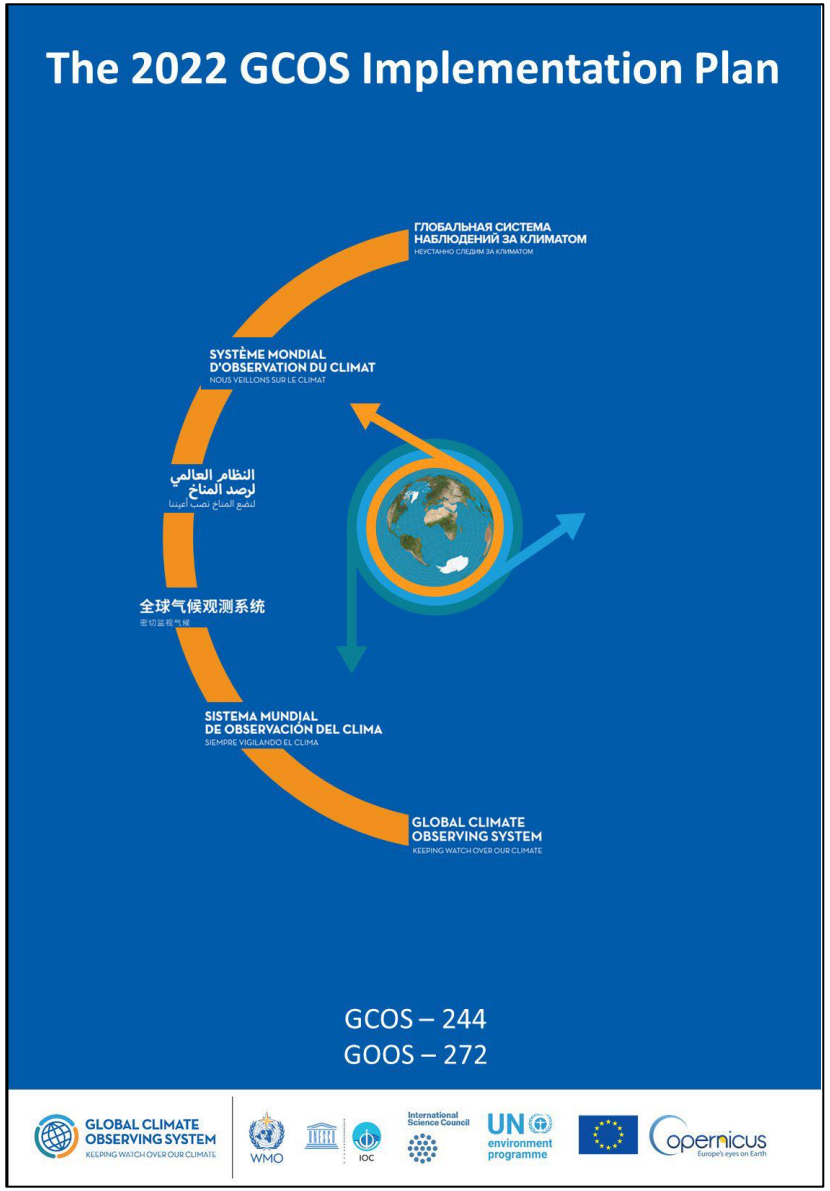
Space-based Component of the Global Observing System

(source, WMO Space Program)



Lightning Climate Data Requirements

- Total Lightning Stroke Density
- Thunder Hours
  - Consistent, Harmonized Data
- Global 10 km x 10 km (0.1 x 0.1 deg)
- Temporal (Monthly, Daily, Hourly)
- Space-based Optical:
  - NASA TRMM/ISS - LIS
  - NOAA/NASA GOES - GLM
  - CMA FY-4 - LMI
  - EUMETSAT MTG - LI
- Ground-based RF (commercial data):
  - GLD360 (Vaisala)
  - ENTLN (Earth Networks)
  - WWLLN (Univ. Washington)
  - Regional Networks (IC/CG)



DEFINITIONS

CURRENT (GCOS-245, 2022)

- An **Essential Climate Variables (ECV)** is a physical, chemical or biological variable (or group of linked variables) that critically contributes to the characterization of Earth's climate.

- An **ECV product** is a measurable parameter needed to characterize the ECV.

FUTURE

ECV products renamed as ECV quantities (to indicate more clearly that these are measurable aspects that can be quantified in some way) and the ECV definition has been modified to show that they can comprise multiple quantities.

- **ECV quantity**: property of phenomenon, body, or substance, where the property has a magnitude that can be expressed as a number and a reference[1]. An ECV may be described by one or more such quantities. Categorical quantities are possible (e.g. precipitation type, land cover class).

- An **Essential Climate Variable (ECV)** is a singular quantity or a collective set of well-defined quantities that critically contribute to the characterization of Earth' s climate. ECV quantities can be physical, chemical or biological.

[1]International vocabulary of metrology – Basic and general concepts and associated terms (VIM)

2022 GCOS 5-year Implementation Plan: Remaining and Additional Activities
Presented at AOPC28

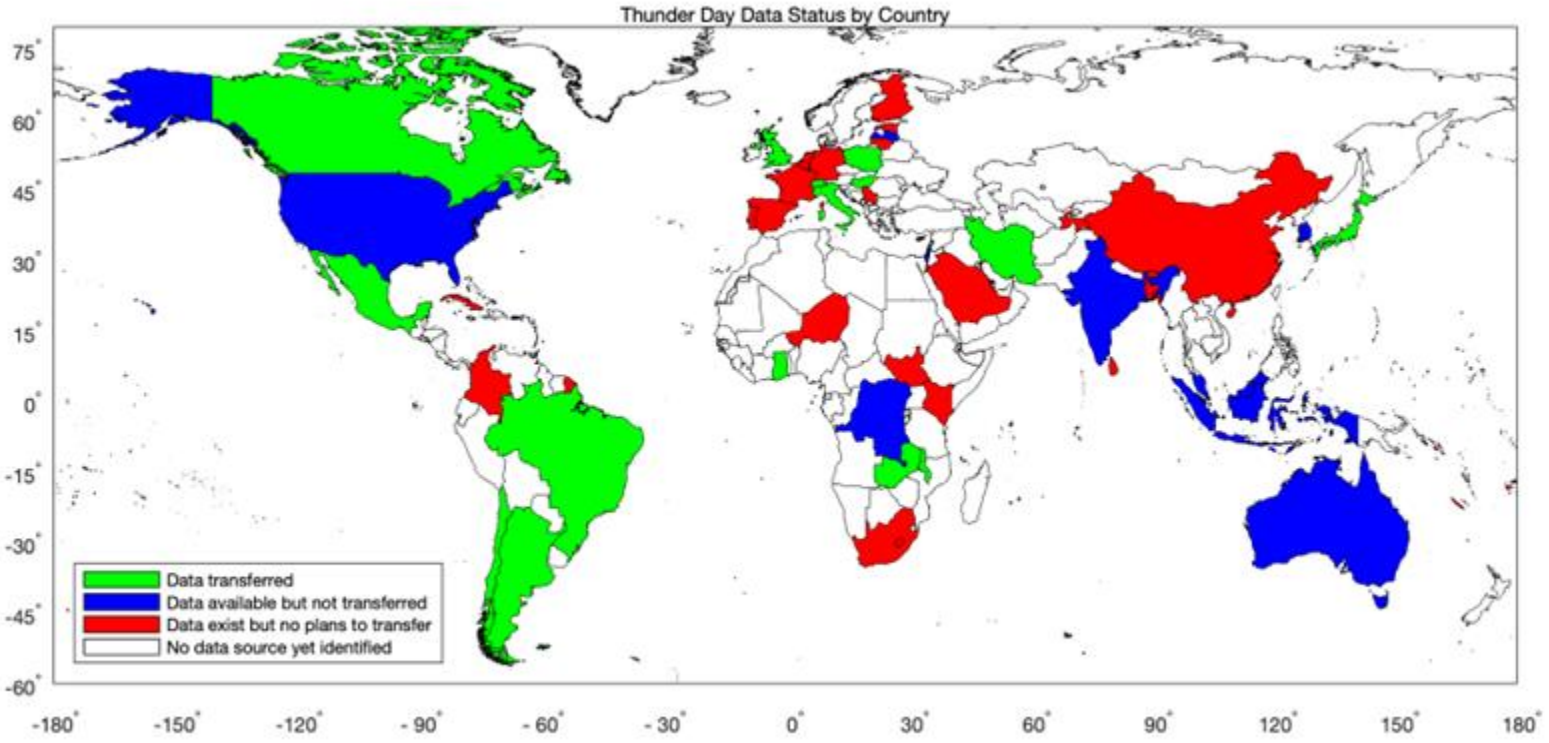
- Activity
  - TT-LOCA two-year extension planned principally to establish the stewardship of the Lightning ECV. Naming a liaison to the AOPC for further coordination through 2024 also under consideration to evaluate the space-based and ground-based ECV data sets, reprocessing, and initial results from the MTG-LI.
  - Continue outreach to operators of regional ground-based lightning networks to provide ECV compatible data sets.
  - Drafted a summary report to follow the initial GCOS-227 Report “Lightning for Climate”.
- Plans for ECV Data Stewardship
  - Global VLF operators (GLD360, ENGLN, WWLLN) offered to provide stewardship, maintain and update their ECV product (monthly gridded product, Thunder Hour)
  - **NOAA NCEI** - stewardship of operational and GLM reprocessed data
  - **NASA** – GHRC DAAC stewardship of the OTD/LIS reprocessed data, and Cloud Service landing page (to be developed and coordinated with NCEI) for all Lightning ECV products.

Thunder Day Record – Data Rescue

Status:
TTLOCA requested assistance from WMO/GCOS in obtaining the missing Thunder Day Records.

Peter Thorne, Maynooth Univ. & GCOS AOPC Chair identified MS student to evaluate the quality of the Thunder Day Records – on hold

A methodology developed by Lavigne and Liu, JGR 2019) can be used to analyze the extended data base.



Climate Information to Inform the Future

Climate at a Glance

Billion-Dollar Disasters

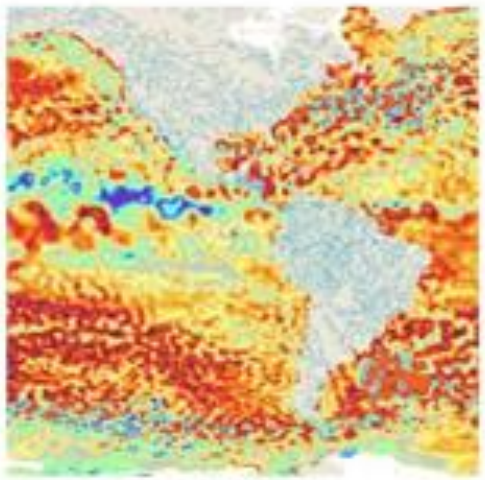
U.S. Drought Monitor

Regional Snowfall Index

Tornado Climatology

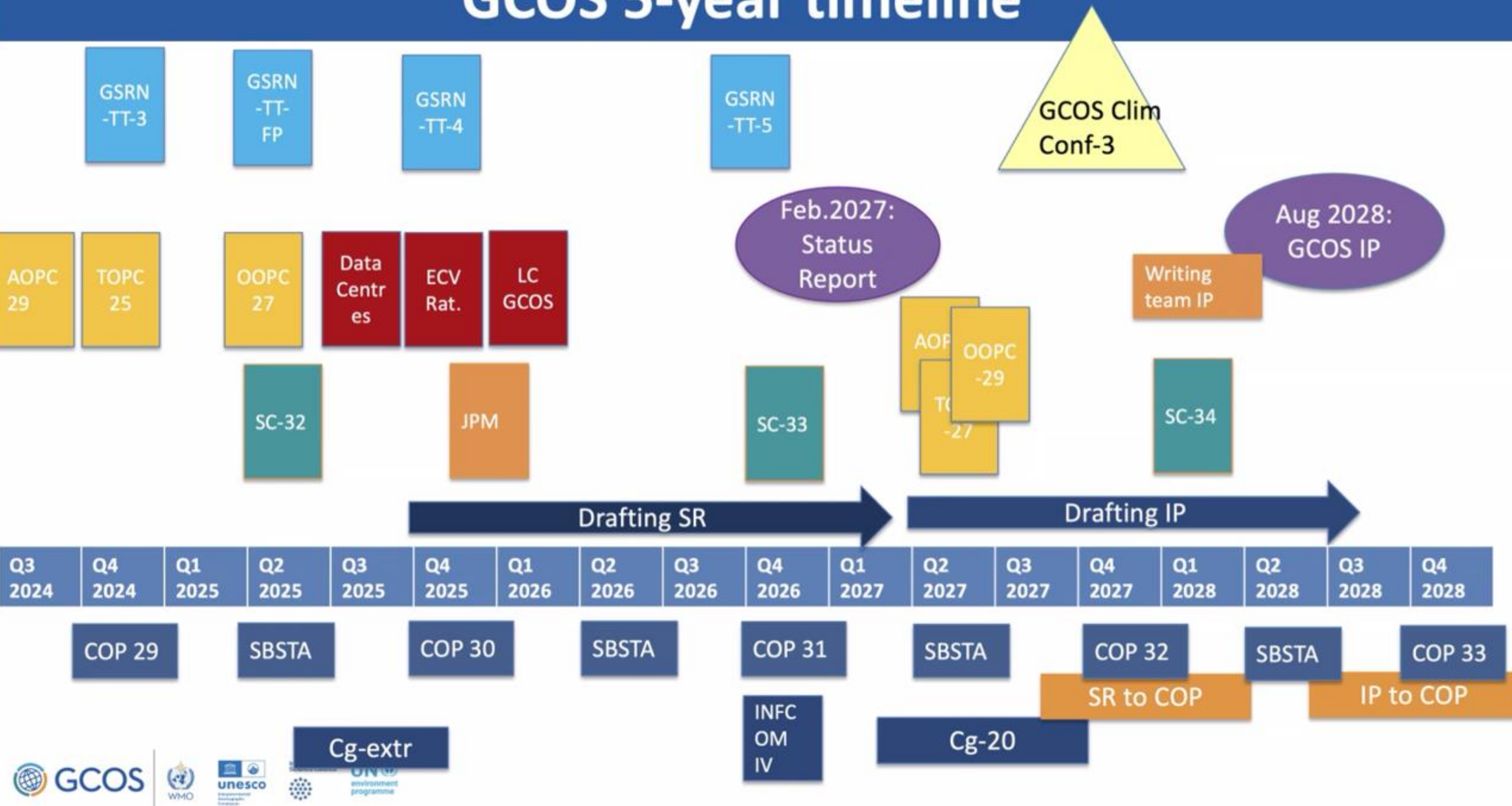
Hourly Precipitation Data

Climate Extremes Index



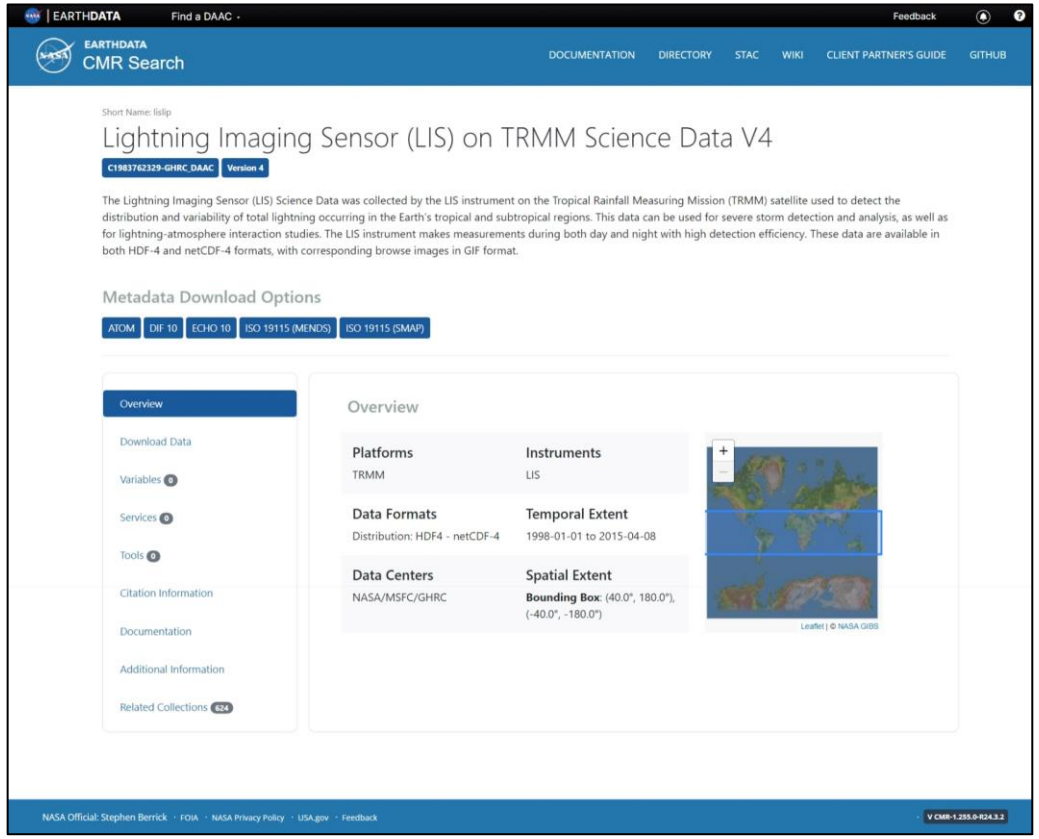
Blended Sea Winds

GCOS 5-year timeline



Data Stewardship at NASA's Earthdata Portal

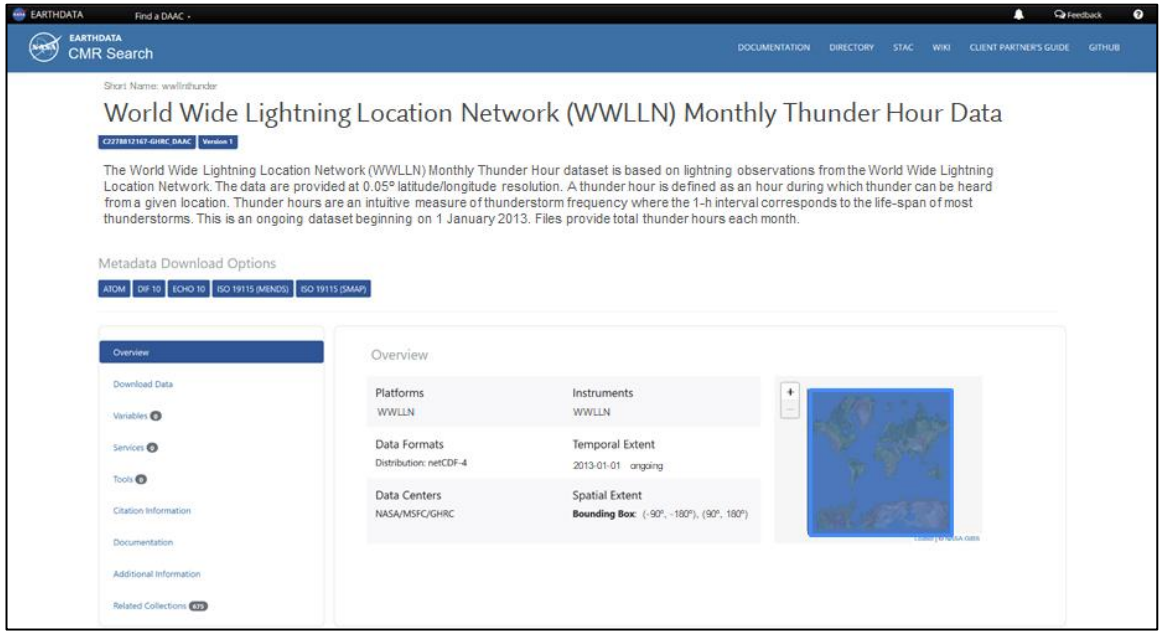
[CMR Search - Landing Pages for GHRC_DAAC EOSDIS Collections (nasa.gov)]



NASA Earth Science Data portal web page for LIS monthly data sets.

Some of the advantages of this dataset being accepted to a NASA DAAC are

- Cloud-based archive to enable easier access, processing in the cloud, and access to other archived lightning data
- Long-term storage: This is more than a web page on a single server. The DAACs provide free access for years to come, complete with redundant backups
- GHRC DAAC, through a user working group is developing visualization and analysis tools to support science use



NASA Earth Science Data portal web page for WWLLN monthly data sets.

Summary

- **<u>TTLOCA Final Report</u>** – AOPC Review due 15 October

- **<u>Exemplary lightning datasets</u> –** evaluating candidate data sets (satellite – Ground-Based RF)
  - Lightning Density
  - Thunder Hour (WWLLN, ENGLN, GLD360, GLM)
  - Gridded at 0.1 x 0.1 deg (GLD360, WWLLN, GLM, MTG-LI, Regional Networks)
  - Developing input to the GCOS 5 – year Implementation Plan
  - Archive and Stewardship in the cloud supported by the NASA GHRC Hydrometeorology DAAC (Distributed Active Archive Center)
- **<u>How might a lightning ECV be associated with other variables</u> -** such as clouds, precipitation, composition, NOx, and surface observations (e.g., temperature, severe weather reports), ENSO, MJO, Upper-Level humidity.

- **<u>Raise lightning safety awareness</u>** – collaborate with WHO, WMO Disaster Risk Reduction (Natural Hazards) Programme

Acknowledgements

- Katrina Virts – Univ. of Alabama in Huntsville (UAH)
- Geoffrey Stano – UAH
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